EXTRACTION OF NITRATE IONS BY DONNAN DIALYSIS
PREDICTION OF THE BATCH PROCESS FROM ELECTRICAL CONDUCTIVITY AND EQUILIBRIUM DATA

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Introduction

Donnan dialysis is an ion exchange through an ion exchange membrane. In the experiments reported here we exchange nitrate ions and chloride ions through a permselective anion exchange membrane. We have computed the ion diffusivities using the simple binary Nernst-Plank equation. In this paper, we perform batch Donnan dialysis experiments at low ionic strength of the feed solution. We exchange nitrate and chloride ions through an ACS (Tokuyama Soda) anion exchange membrane. We compare the experimental results to the prediction obtained from the binary Nernst-Planck equation.

Computation of the diffusion coefficients

To compute the diffusivity of both counter ions (nitrate and chloride) we first perform equilibriuum measurements. From equilibrium experiments we get the selectivity coefficient ($\alpha_1^2 = 1.845$) and the concentration of the fixed charges($\overline{c_4} = 1.07 mol / l$). We perform electrical conductivity measurements at variable nitrate/chloride concentration in the membrane: by fitting the conductivity vs. concentration curve with the Nernst-Planck conductivity equation we obtain the diffusivity of the chloride and the nitrate ion in the membrane.

Theory

We compare the computed mass transfer coefficients from the experimental batch dialysis data to the prediction given by the laminar Leveque correlation. The following assumptions are used to compute the diffusion model:

- Nernst-Planck equation holds in the film and in the membrane
- The membrane is ideally permselective
- The concentration of the extracted counter-ion in the strip solution is constant durig the batch dialysis experiment
- The film resistance coefficient at the strip side is neglected (the concentration of the strip solution is high).

Results and discussion

The prediction of the nitrate concentration vs. time curve is quantitative. We could even predict the batch dialysis curves when the source solution was a mixed concentrated NaCl/NaNO3 electrolyte solution and when the Reynolds number at the feed side varies.